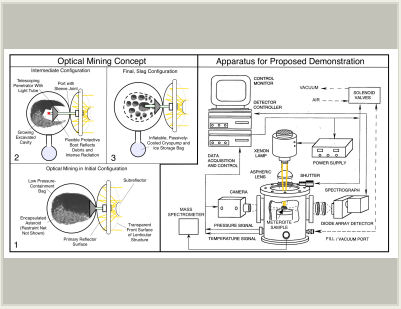
Small Business Innovation Research/Small Business Tech Transfer

Demonstration of "Optical Mining" For Excavation of Asteroids and Production of Mission Consumables, Phase I

Completed Technology Project (2015 - 2015)

Project Introduction

This SBIR Phase-1 project will demonstrate the feasibility of an innovative breakthrough in ISRU methods that we call "Optical Mining". Optical mining is an approach to simultaneously excavating carbonaceous chondrite asteroid surfaces and driving water and other volatiles out of the excavated material and into an enclosing inflatable bag without the need for complex or impractical robotics. In optical mining, highly concentrated sunlight is delivered to the surface of the asteroid through a mechanically simple but optically sophisticated system of reflective non-imaging optics. The highly concentrated optical energy ablates the surface in a controlled way analogous to how intense lasers can ablate surfaces constantly exposing new material and forcing water out of the ablated material. Optical mining is part of a mission concept that ICS Associates has developed called Apis (Asteroid Provided In-Situ Systems). Apis is a commercially viable approach to the extraction, processing, and delivery of water from asteroids to in-space assets. Mission system studies show that Apis can extract up to 100MT of water from an accessible near Earth asteroid and deliver it to Lunar Distant Retrograde Orbit (LDRO) based on the launch of just one modest sized spacecraft from a single Falcon 9 rocket. The Apis mission concept depends on the completion of the proposed SBIR work. In this Phase-1 SBIR we will develop a facility to simulate and demonstrate key aspects of optical mining to show the mission system feasibility of Apis and provide a breakthrough in ISRU and space transportation for NASA. We will do this by upgrading an existing xenon arc lamp and vacuum system and using the optical energy from the lamp to simulate optical mining on asteroid materials in vacuum. We will perform experiments to validate the process by optically ablating the surfaces of meteorite samples and asteroid simulations under carefully controlled and observed conditions.



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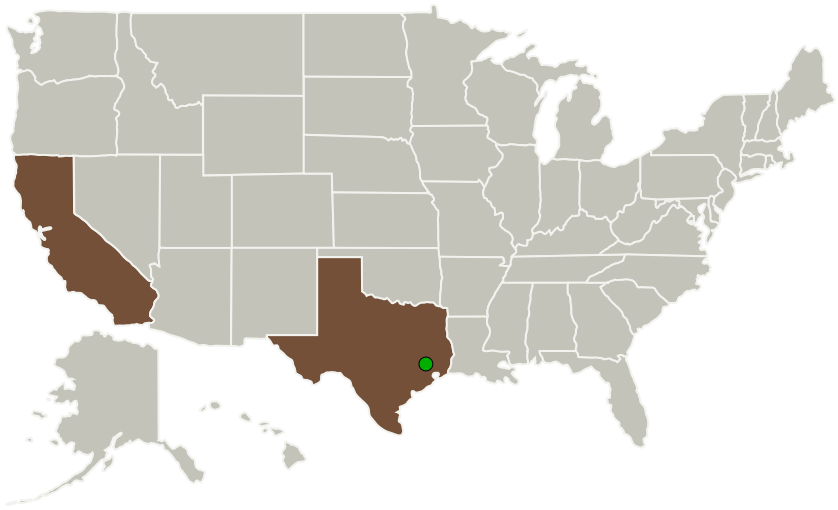
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Integrated Concurrent System Associates, Inc.	Lead Organization	Industry	
Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas

Primary U.S. Work Locations	
California	Texas

Project Transitions

June 2015: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Integrated Concurrent System Associates, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

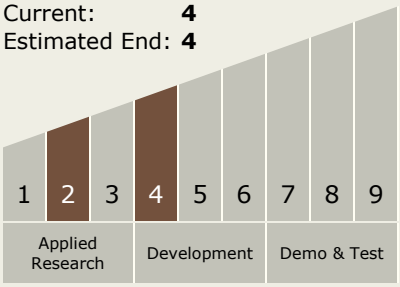
Carlos Torrez

Principal Investigator:

Joel C Sercel

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



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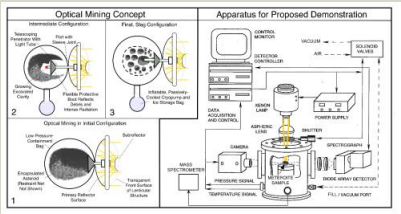
December 2015: Closed out

Closeout Summary: Demonstration of "Optical Mining" For Excavation of Asteroids and Production of Mission Consumables, Phase I Project Image

Closeout Documentation:

- Final Summary Chart Image*(https://techport.nasa.gov/file/138918)*

Images



Briefing Chart Image
Demonstration of "Optical Mining" For Excavation of Asteroids and Production of Mission Consumables, Phase I
(https://techport.nasa.gov/image/127114)

Technology Areas

Primary:

- TX07 Exploration Destination Systems
  - TX07.1 In-Situ Resource Utilization
    - TX07.1.2 Resource Acquisition, Isolation, and Preparation

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System